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Is it Safe to Place a Peripherally Inserted Central Catheter Line in Patients with Bacteremia? A Retrospective Cohort Study at a Single Institution

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Abstract

Background: The use of peripherally inserted central catheter (PICC) lines has steadily grown in hospital settings. We investigated the factors associated with positive blood cultures after PICC line insertion. We also assessed whether pre-PICC blood culture status affects post-insertion blood stream infection (BSI).

Methods: A retrospective record review was conducted for all hospitalized patients receiving PICC lines at King Abdul-Aziz University Hospital (Jeddah, Saudi Arabia) from February 2015 through January 2017. Two groups were studied according to pre-PICC line blood culture status (i.e., the positive blood culture and negative blood culture groups prior to PICC line insertion). Information regarding fever, white blood cell (WBC) count, and blood cultures performed during or after PICC line removal was collected.

Results: The sample included a total of 202 patients with PICC lines. We found a statistically significant relationship between PICC line-associated BSI and increased dwell time of PICC insertion (p=0.0001), increased length of hospital stay (p=0.0001), and non-Saudi nationality (p=0.025), respectively. Positive blood cultures during or after the removal of PICC lines were not significantly dependent on prior positive cultures or high WBC count.

Conclusion: The incidence of BSI after PICC line insertion in patients with prior positive culture was no different from that of patients without prior positive culture. These cultures included positive blood or any other cultures. Factors associated with BSI after PICC line insertion at King Abdul-Aziz University Hospital included dwell time of the PICC line, length of hospital stay, and non-Saudi nationality.

Keywords: Bacteremia; PICC; Dwell time

Introduction

The use of peripherally inserted central catheter (PICC) lines has steadily grown in hospital settings. Approximately 8% of patients in critical care settings require central venous access during their hospital stay [1]. Peripherally inserted central catheter lines provide several advantages over classical central venous catheters (CVCs): insertion safety, removal safety, and cost-effectiveness. Moreover, a PICC line serves as a multipurpose device, it has an increased dwell time, and it obviates the need for frequent cannulation [2,3].

Indications, contraindications, and potential complications must be considered prior to the insertion of a PICC line. The most common indications for PICC line use include frequent blood sampling and the need to deliver blood components, parenteral nutrition, or treatments considered to be vesicants or irritating (e.g., chemotherapy or antibiotics) [4]. Contraindications for the use of PICC lines include overt sepsis, bacteremia, skin infections, and burns [5,6].

Of all PICC line complications associated with increased morbidity, infections and vein thrombosis are the most important. Depending on a patient's health, these complications may even increase mortality rates [4,7]. According to the Centers for Disease Control and Prevention (CDC), blood stream infections (BSIs) can be defined as the presence of viable bacteria in the blood (i.e., bacteremia) documented by a positive blood culture result [8]. In 2019, Krein et al conducted a multicenter prospective cohort study of the 70-day follow-up period of 438 patients who had received a PICC line. Over half (61.4%) of the patients reported signs of at least one potentially serious complication such as a BSI (17.6%) or deep vein thrombosis (30.6%) [9].

Other serious and life-threatening complications related to the insertion of PICC lines (e.g., pneumothorax and hemothorax) are exceedingly rare [2]. In a systematic review and meta-analysis of 23 studies conducted by Chopra et al. 13 studies (50,667 patients) concluded that the risk of PICC-related BSIs was 0.91% (95% CI 0.46–1.79). Other factors associated with PICC line-related BSIs include admission to an intensive care unit (ICU), hospital length of stay (LOS), number of PICC line lumens, and patients with hematological malignancies or individuals receiving chemotherapy [7-20]. For children and infants, PICC lines are considered to be safe and may be used for prolonged periods; the rates of infectious complications of PICC lines are lower than for tunneled CVCs [17,21-25].

We investigated factors associated with positive blood cultures after PICC line insertion. We also assessed whether pre-PICC blood culture status affects post-insertion BSIs.

Methods

Patient selection

We conducted a retrospective record review of all consecutive hospitalized patients who had received PICC lines at King Abdul-Aziz University Hospital (Jeddah, Saudi Arabia).

Inclusion criteria

All patients at King Abdul-Aziz University Hospital who underwent PICC line insertion and were registered in the PICC line database at the interventional radiology from 18 February 2015 through 24 January 2017.

Data collection

We used the interventional radiology database to retrieve patients' medical record numbers (MRNs). The MRNs were then used to collect additional data from the electronic hospital system: patient age, gender, nationality, presence or absence of chronic diseases (e.g., diabetes, hypertension, heart disease, bone infections, lung infections, and cancer), indication of use, insertion site of the PICC line, hospital LOS, and dwell time of the PICC line in days. The study was approved by the Institutional Review Board of King Abdul-Aziz University Hospital.

Patients' blood and other culture status

We divided the patients into two groups according to their blood culture status prior to PICC line insertion within the same hospital admission. Individuals with positive blood cultures were placed in the "positive blood culture group"; individuals with negative blood cultures were placed in the "negative blood culture group." In addition, the results of blood cultures performed during or after PICC line removal were obtained. Other cultures (i.e., urine, stool, sputum, and wound swab cultures) prior to PICC line insertion were obtained as well. Moreover, any fever (defined as >37.8 C) recorded on the same day prior to PICC line insertion was documented, and WBC count prior to PICC line insertion was documented as well.

Statistical analysis

We used SPSS version 20.0 for all of the statistical analyses. The Shapiro-Wilk test was used to test the normality of the study sample. Descriptive statistics (i.e., mean, standard deviation, median, and quartiles) were also calculated as necessary. When the data were not normally distributed, we used the Mann-Whitney U test to compare differences between two independent groups. We used the chi-squared test to test the relationship between two variables. A p-value less than 0.05 was assumed to indicate statistical significance.

Results

The clinical characteristics of the patients are presented in Table 1. The records from a total of 202 patients with inserted PICC lines were analyzed. Most of the patients were between the ages of 15 and 65 (70.8%). Roughly half (57.4%) of the sample was female. Only 46.0% of the patients were of Saudi nationality. About half (58.9%; n=119) of the patients had been diagnosed with an oncological disease, and 62.9% (n=127) of the patients had been diagnosed with an infection. The most common indication for PICC line insertion was total parenteral nutrition (TPN), followed by antibiotic administration (42.1% and 38.1%, respectively). The most frequent blood culture isolates before, during, or after PICC line insertion were coagulase-negative staphylococci. In cultures taken prior to PICC line insertion, Enterococcus faecalis and Staphylococcus aureus were the most common. In cultures obtained while patients had a PICC line, Enterococcus faecalis and Klebsiella pneumoniae were the most common. After removal of a PICC line, Staphylococcus aureus was the most common blood culture isolate.

Patient characteristic	**N (%)**
Age (years): 0-14	17 (8.4%)
15-65	143(70.8%)
>65	42 (20.8%)
Gender: Male	86(42.6%)
Female	116(57.4%)
Nationality: Saudi	93(46.0%)
Non-Saudi	109(54.0%)
Chronic illness: Cancer	119(58.9%)
Infection	127(62.9%)
Kidney disease	193(95.5%)
Heart disease	172(85.1%)
Chronic disease	201(99.5%)
Indication of use:	
TPN	85(42.1%)
Antibiotic	77(38.1%)
Chemotherapy	31(15.3%)
Other drug administration	9(4.5%)
Site of insertion:	
Basilic vein	166(82.2%)
Brachial vein	20(9.9%)
Cephalic vein	6(3.0%)
Not available	10(5.0%)
Fever onday of PICC line insertion:	15(7.4%)
High WBC prior to PICC line insertion*	60(29.7%)
Positive cultures prior to PICC line insertion*:	
Blood	42(20.8%)
Urine	20(9.9%)
Stool	2(1.0%)
Wound	52(25.7%)
Sputum	20(9.9%)
Positive blood culture during PICC line	58(28.7%)

Positive Blood culture after removal of PICC line	27(13.4%)
Dwell Time of PICC line (days): Median, range	21 (1-180)
Length of Hospital Stay (days): Median, range	54 (1-1230)
* at any point within the same admission	

Table 2 lists the factors that predict positive blood cultures during or after PICC line insertion. A statistically significant relationship between nationality and PICC-related BSI was observed. Individuals of non-Saudi nationality with positive blood cultures constituted 43.1% of the sample; Saudi nationals constituted only 28.0% of the sample (p=0.025).

Table 1: Clinical characteristics of patients.

Predictor variables		**Blood culture positive either during or after removal of PICC line**	**Blood culture negative either during or after removal or not done**	**p-value**
Gender	Male	35(40.7%)	51(59.3%)	0.245
	Female	38(32.8%)	78 (67.2%)	
Nationality	Saudi	26(28%)	67(72%)	0.025
	Non-Saudi	47(43.1%)	62 56.9%)	
Age (years)		51 years	53 years	0.311
Dwell time of PICC in days		29 days	18 days	0.0001
LOS (Length of hospital stay in days)		87 days	41 days	0.0001
Cancer	Yes	41(34.5%)	78(65.5%)	0.551.
	No	32(38.6%)	51(61.4%)	
Infection	Yes	52(40.9%)	75(59.1%)	0.064
	No	21 (28%)	54 (72%)	
Chronic disease	Yes	72(35.8%)	129(64.2%)	-
	No	1 (100%)	0 (0%)	
Indication of use	TPN	33(38.8%)	52 (61.2%)	0.073
	Drug administration	6 (66.7%)	3 (33.3%)	
	Antibiotic	21(27.3%)	56 (72.7%)	

	Chemotherapy	13(41.9%)	18 (58.1%)	
Site of insertion	None	3 (30.0%)	7 (70.0%)	-
	Basilic vein	57(34.3%)	109(65.7%)	
	Brachial vein	10(50.0%)	10 (50.0%)	
	Cephalic vein	3 (50.0%)	3 (50.0%)	
Prior WBC	Yes	24 (40%)	36 (60%)	0.458
	No or Not needed	49(34.5%)	93 (65.5%)	
Fever	Yes	6 (40%)	9 (60%)	0.746
	No or Not needed	67(35.8%)	120(64.2%)	
Prior blood culture	Positive	20(47.6%)	22(52.4%)	0.082
	Negative/not needed	53 (33.1%)	107 (66.9%)	
Urine culture prior PICC	Positive	11 (55%)	9 (45%)	0.064
	Negative/not needed	62(34.1%)	120(65.9%)	
Prior wound swab	positive	20(38.5%)	32 (61.5%)	0.686
	Negative/not needed	53(35.3%)	97 (64.7%)	
Prior sputum culture	positive	10 (50%)	10 (50%)	0.174
	Negative/not needed	63(34.6%)	119 (65.4%)	
-: p value cannot be computed as more than 20% of cells have count less than 5				

Table 2: Determining relationship between predictor variables and the outcome variable blood culture positive either during or after removal of PICC line.

The BSI rate in patients who had received or still currently had a PICC line was significantly associated with increased dwell time of catheterization (29 days for positive blood cultures compared with 18 days in negative cultures; p=0.0001) and increased LOS (87 days for positive blood cultures compared with 41 days for negative blood cultures; p=0.0001).

Other factors, including prior positive cultures, high WBC counts, gender, age, medical diagnosis, location of the catheter, indication of use, and co-morbidities, were not statistically significant.

Discussion

Peripherally inserted central catheter lines are used often in hospitals; BSIs are the complication of most concern. There is a general

belief that PICC line insertion in patients with bacteremia will predispose them to PICC line infections. Consequently, the practice at some centers is to delay PICC line insertion until the infection has been resolved. Furthermore, this practice is consistent with most guidelines, which are based on expert consensus [11]. Currently, the literature contains no evidence to support or reject this practice. A recent study by Stewart et al. concluded that the placement of PICC lines among patients with Staphylococcus aureus bacteremia is very safe and does not increase the rate of subsequent infection related to PICC line insertion [12].

In this study, we retrospectively reviewed the records of 202 patients with PICC lines at King Abdulaziz University Hospital in order to identify factors associated with the development of BSIs related to PICC line insertion. The development of a BSI either during or after the removal of a PICC line was strongly associated with the dwell time of the PICC line (p=0.0001). We noted a median dwell time of 29 days for a PICC line. In a retrospective study conducted by Yap et al., 88 PICC lines were inserted in 73 patients [13]. These authors found a median dwell time of 44 days. In Cheong et al.'s retrospective study, 27 PICC lines were inserted in 17 patients. Cheong et al. found that the median dwell time was 20 days; moreover, the mean time that elapsed until a complication occurred was 27.5 days [14]. Our study suggests that removing a PICC line in 29 days will decrease the rate of PICC-related BSIs.

Nationality (i.e., Saudi vs. non-Saudi) was another variable that we found to be associated with an increased risk of BSIs (p=0.025). Based on our results, non-Saudi patients were more likely to have positive blood cultures either during or after PICC line insertion. This discrepancy may be explained by language barriers, which may lead to poor adherence to instructions.

Furthermore, hospital LOS appeared to have a significant, direct effect on the development of BSIs during or after the removal of a PICC line (p<0.0001). In addition, the median LOS for patients with BSIs was significantly longer than for patients without BSIs (87 vs. 41 days, respectively). A retrospective cohort study by Chopra et al. found that hospital LOS was associated with an increased risk of PICC line-associated BSIs, which is consistent with our findings.

Other variables—such as age, gender, cancer status, overall infection, chronic diseases, indication of use, site of insertion, WBC count prior to PICC line insertion, febrile status on the same day of PICC insertion, and cultures (e.g., blood, urine, wound, and sputum) prior to PICC line insertion—were not significantly associated with an increased risk of BSIs during or after the removal of a PICC line. As noted previously, this study suggests that PICC line insertion among patients with bacteremia is safe and not associated with an increased risk of a BSI either during or after the removal of a PICC line. Therefore, there is no obvious reason to delay the insertion of a line. This conclusion is supported by a retrospective study that revealed that no relationship between early or late insertion of a PICC line among patients with bacteremia and an increased risk of PICC line-associated BSIs [12]. Furthermore, another cohort study conducted in both inpatient and outpatient settings found that PICC-related BSIs were less likely to occur than other complications [15].

There are multiple limitations to our study. First, this investigation was a retrospective study, which means that not all information was available. This situation exists because of poor documentation and/or a lack of data entry in electronic records. Documentation in our electronic hospital system did not start until 2015; therefore, we were unable to include patients treated earlier. We were only able to collect information for 202 patients, which is not a very large sample size for drawing conclusions regarding a population. Furthermore, this study was only conducted at one health center; it should be extended to include other health centers. Nevertheless, we have a sufficiently large sample size for our purposes.

Conclusion

We have demonstrated statistically significant risks of BSIs during and after the removal of PICC lines; these risks are associated with increased dwell times of the PICC lines, increased hospital LOS, and non-Saudi nationality. Positive blood cultures during or after the removal of PICC lines were not significantly dependent on prior positive cultures. We recommend the removal or exchange of a PICC line if one is needed for more than one month. We also suggest decreasing the hospitalization period to less than three months, if possible, and using more effective ways to communicate with non-Saudi patients. Ultimately, policies delaying PICC line insertion in patients with bacteremia should be reconsidered.

References

1. Ruesch S, Walder B, Tramèr MR (2002) Complications of central venous catheters: internal jugular vs. subclavian access: a systematic review. Critical Care Medicine 30: 454-460.
2. Ault MJ, Ellrodt AG, Maldonado L (1997) Peripherally inserted central catheters in general medicine. In: Mayo Clinic Proceedings 72: 225-233.
3. Sundriyal D, Shirsi N, Jain S, Mittal G, Khivasara J, et al. (2014) Peripherally inserted central catheters: our experience from a cancer research centre. Indian J Surg Oncol 5: 274-277.
4. Parás-Bravo P, Paz-Zulueta M, Sarabia-Lavin R, Amo-Setien FJ, Herrero-Montes M, et al. (2016) Complications of peripherally inserted central venous catheters: a retrospective cohort study. PloS One 11: 0162479.
5. Hertzog DR, Waybill PN (2008) Complications and controversies associated with peripherally inserted central catheters. J Infus Nurs 31: 159-163.
6. Pittiruti M, Brutti A, Celentano D, Pomponi M, Biasucci DG, et al. (2012) Clinical experience with power-injectable PICCs in intensive care patients. Crit Care 16: 21.
7. Ajenjo MC, Morley JC, Russo AJ, McMullen KM, Robinson C (2011) Peripherally inserted central venous catheter–associated bloodstream infections in hospitalized adult patients. Infect Control Hosp Epidemiol 32: 125-130.
8. Bouzad C, Duron S, Bousquet A, Arnaud FX, Valbousquet L (2016) Peripherally inserted central catheter-related infections in a cohort of hospitalized adult patients. Cardiovasc Intervent Radiol 39: 385-393.
9. Chopra V, Flanders SA, Saint S (2012) The problem with peripherally inserted central catheters. Jama 308: 1527-1528.
10. Chopra V, Ratz D, Kuhn L, Lopus T, Chenoweth C (2014) PICC-associated bloodstream infections: prevalence, patterns, and predictors. Am J Med 127: 319-328.
11. Chopra V, Flanders SA, Saint S, Woller SC, O'Grady NP, et al. (2015) The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC): results from a multispecialty panel using the RAND/UCLA appropriateness method. Ann Intern Med 163: 1-40.
12. Stewart JD, Runnegar N (2018) Early use of peripherally inserted central catheters is safe in Staphylococcus aureus bacteraemia. Intern Med J 48: 44-49.
13. YAP YS, Karapetis C, Lerose S, Iyer S, Koczwara B (2006) Reducing the risk of peripherally inserted central catheter line complications in the oncology setting. Eur J Cancer Care (Engl) 15: 342-347.

14. Cheong K, Perry D, Karapetis C, Koczwara B (2004) High rate of complications associated with peripherally inserted central venous catheters in patients with solid tumours. Internal Medicine 34: 234-238.
15. Grau D, Clarivet B, Lotthé A, Bommart S, Parer S (2017) Complications with peripherally inserted central catheters (PICCs) used in hospitalized patients and outpatients: a prospective cohort study. Antimicrob Resist Infect Control 6: 18.
16. Krein SL, Saint S, Trautner BW, Kuhn L, Colozzi J, et al. (2019) Patient-reported complications related to peripherally inserted central catheters: a multicentre prospective cohort study. BMJ Qual Saf 28: 574-581.
17. Levy I, Bendet M, Samra Z, Shalit I, Katz J (2010) Infectious complications of peripherally inserted central venous catheters in children. The Pediatric Infectious 29: 426-429.
18. Herc E, Patel P, Washer LL, Conlon A, Flanders SA (2017) A model to predict central-line–associated bloodstream infection among patients with peripherally inserted central catheters: the MPC score. Infection Control & Hospital Epidemiology 38: 1155-1166.
19. Yilmaz G, Koksal I, Aydin K, Caylan R, Sucu N (2007) Risk factors of catheterrelated bloodstream infections in parenteral nutrition catheterization. Journal of Parenteral 31: 284-287.
20. Costello JM, Graham DA, Morrow DF, Potter-Bynoe G, Sandora TJ, et al. Risk factors for central line-associated bloodstream infection in a pediatric cardiac intensive care unit. Pediatric Critical Care 10: 453-459.
21. Leroyer C, Lashéras A, Marie V, Le Bras Y, Carteret T, et al. (2013) Prospective follow-up of complications related to peripherally inserted central catheters. Médecine Et Maladies 43: 350-355.
22. Chopra V, Anand S, Krein SL, Chenoweth C, Saint S (2012) Bloodstream infection, venous thrombosis, and peripherally inserted central catheters: reappraising the evidence. The American Journal of Medicine 125: 733-741.
23. Westergaard B, Classen V, WaltherLarsen S (2013) Peripherally inserted central catheters in infants and children–indications, techniques, complications and clinical recommendations. Acta Anaesthesiologica 57: 278-287.
24. Zochios V, Umar I, Simpson N, Jones N (2014) Peripherally inserted central catheter (PICC)-related thrombosis in critically ill patients. The Journal of Vascular Access 15: 329-37.
25. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM (1988) CDC definitions for nosocomial infections. APIC Infection Control and Applied Epidemiology: Principles and Practice 16: 128-140.